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## 19. DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES AND RESPONSE ACTIONS

The overall scope and content of the OU 10-04 comprehensive Feasibility Study (FS) report, including assumptions developed to facilitate report preparation, are discussed in this section. The screening and disposition of OU 10-04 sites of concern are discussed in Section 19.1. The assumptions developed for the OU 10-04 FS are listed in Section 19.2. The development of Remedial Action Objectives (RAOs) is presented and the contaminants of concern (COCs), media, exposure pathways of concern, and preliminary remediation goals (PRGs) are identified in Section 19.3. The development of general response actions is presented in Section 19.4. Individual remedial technologies are identified and screened in Section 19.5.

### 19.1 Introduction

The comprehensive OU 10-04 FS addressed the sites forwarded to the FS in Section 18. The evaluation was developed in accordance with EPA *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988). The overall approach was to examine remedial actions that have been evaluated or implemented at the INEEL to define potentially effective and implementable remedial process options for WAG 10 and thus reduce the number of remedial alternatives for detailed analysis.

Sites retained for evaluation in the FS based on carcinogenic human health risks greater than or equal to  $1\text{E-}04$  for one or more exposure scenarios are identified in Table 19-1. The trinitrotoluene (TNT)/Royal Demolition Explosive (RDX) soil sites: Firestation, Fieldstation, Mine/Fuze, NOAA and NODA Area 2 (see Figure 19-1), are the only sites with carcinogenic risks exceeding  $1\text{E-}04$ . The STF-02 Gun Range (see Figure 19-2) and UXO areas (see Figure 19-3) are analyzed in the FS based on noncarcinogenic human health issues.

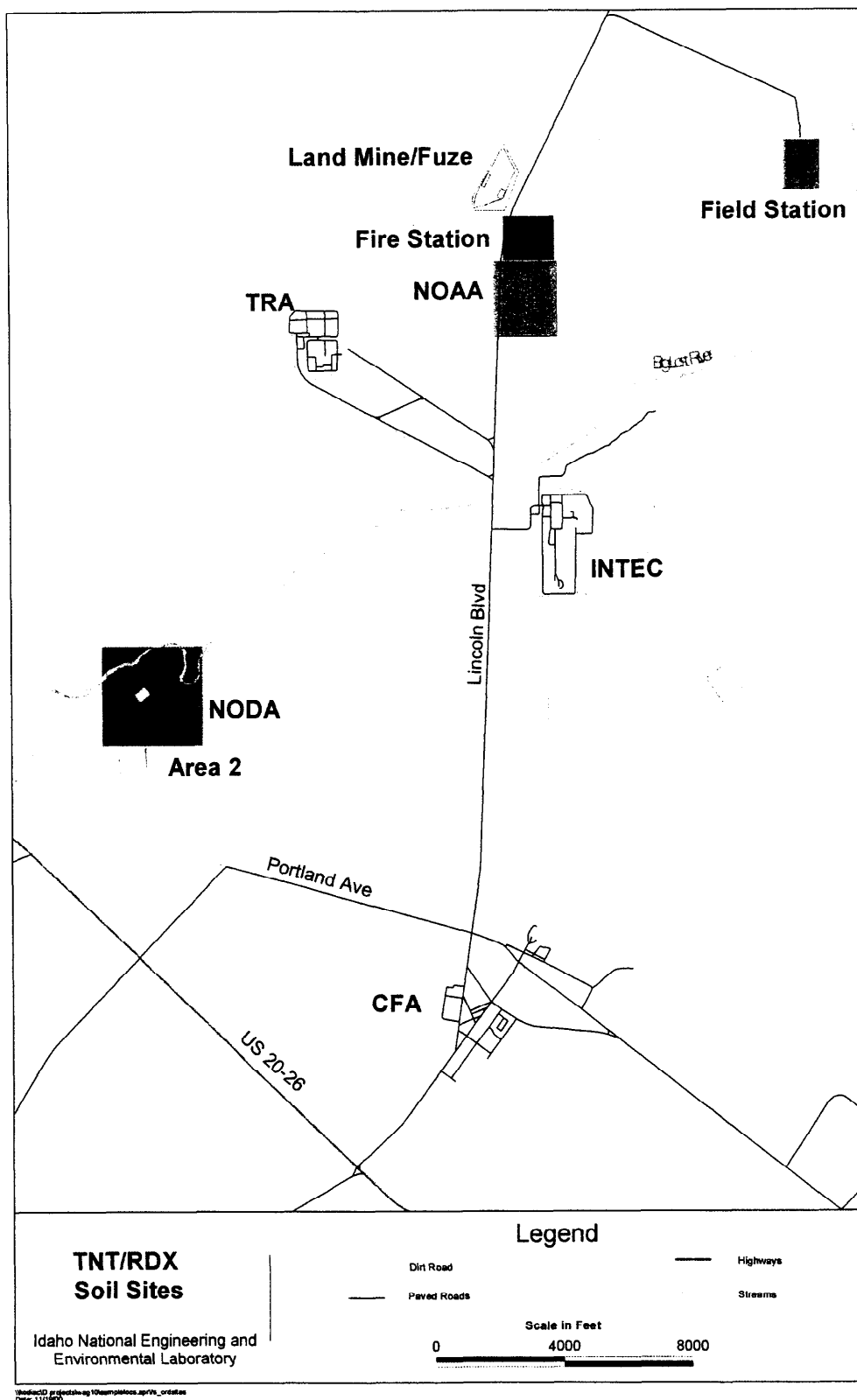
The soil sites retained for evaluation in the FS are identified in Table 19-2. A Hazard Quotient (HQ) of 10.0 was primarily used to determine ecological risk sites and COCs to be addressed in the FS. However, several sites of concern were also evaluated in the OU 10-04 sitewide ERA.

The identification and screening of alternatives focuses on media. Five sites, Firestation, Fieldstation, Mine/Fuze, NOAA, and NODA Area 2 contain soil contaminated with TNT and/or RDX; remedial alternatives are analyzed for the combined soils from these sites. One site, the STF-02 Gun Range, contains soil contaminated with lead and munitions fragments, and remedial alternatives are analyzed specifically for this site. The UXO area contains potential UXO and is also addressed individually. The UXO Area includes all land within the Down Range Area and Bombing Ranges as shown on Figure 19-3, INEEL Ordnance Map. The seven sites addressed in the FS are summarized in Table 19-3, which also indicates whether unacceptable human health or ecological risk is posed by each site.

**Table 19-1.** Sites retained for the feasibility study based on potential future residential human health risks greater than 1.

Site	Exposure Pathway	Contributing COC	Estimated Excess Cancer Risk (exposure route of concern, all areas)	Total Estimated Cancer Risk (all exposure routes, all areas)	Hazard Qu (exposure r concern, all
Firestation	Ingestion of Homegrown Produce	TNT	6E-05	<b>1E-04</b>	9
Fieldstation	Ingestion of Homegrown Produce	TNT	6.00E-05	<b>9E-05</b>	9
Mine Fuze	Ingestion of Homegrown Produce	TNT	4.00E-03	<b>6E-03</b>	600
	Dermal Absorption of Soil	TNT	2.00E-03	—	1
	Ingestion of Soil	TNT	2.00E-04	—	30
NOAA	Ingestion of Homegrown Produce	TNT and RDX	1.00E-03	<b>1E-03</b>	200
	Ingestion of Groundwater	TNT	4.00E-05	—	7
	Ingestion of Soil	TNT	5.00E-05	—	7
	Dermal Absorption of Soil	TNT	4.00E-04	—	0.2
NODA	Ingestion of Homegrown Produce	RDX	3.00E-04	<b>2E-02</b>	2
STF	Groundwater Risk	Lead	N/A *	N/A *	N/A
	Direct exposure	Lead	N/A	N/A	N/A

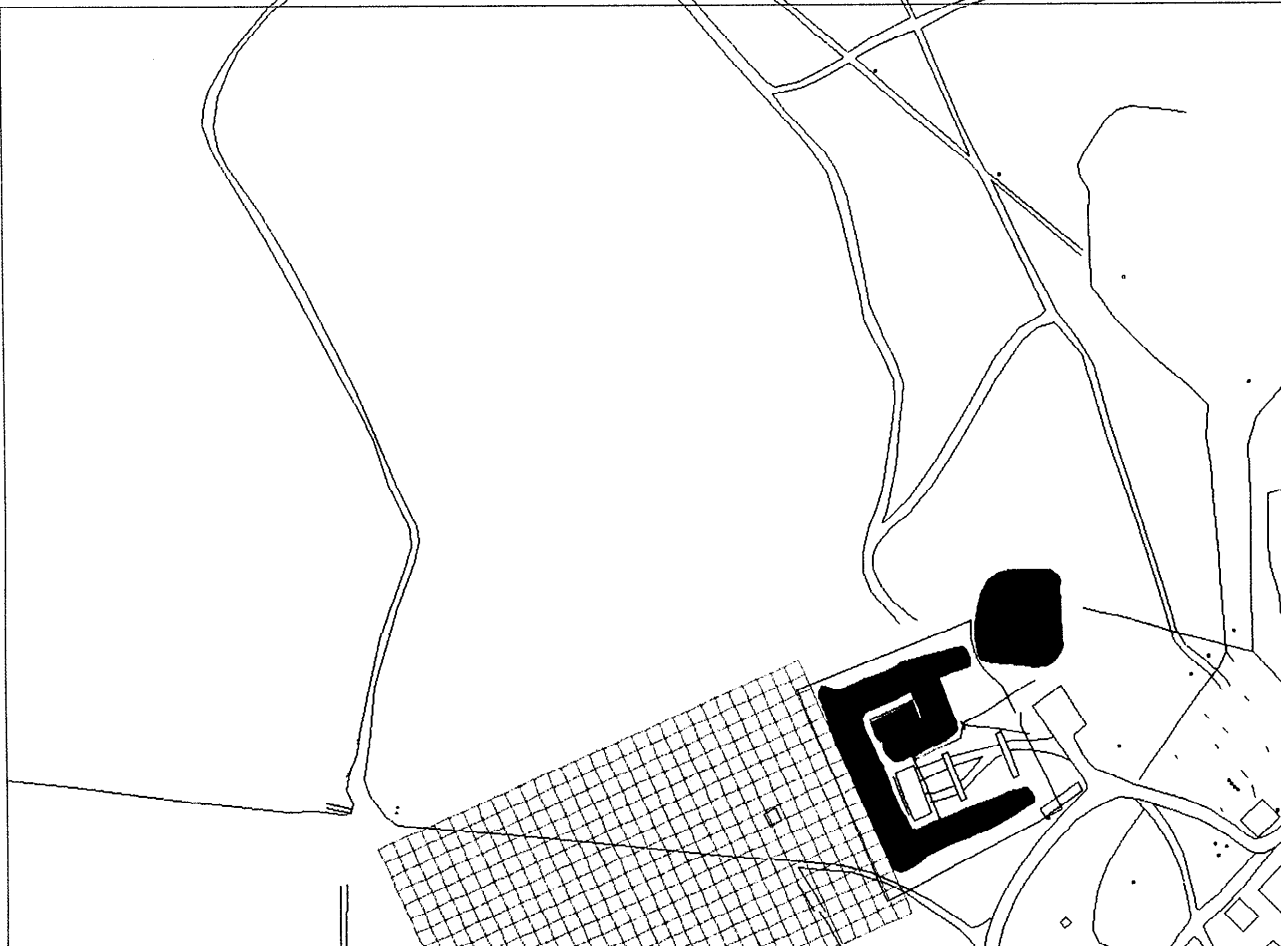
\* Groundwater screens show 2.4 E -01 mg/L vs. EPA maximum contaminant levels (MCLs) of 0.015 mg/L. Groundwater screen methodology is discussed








**Figure 19-1.** TNT/RDX Soil Sites.

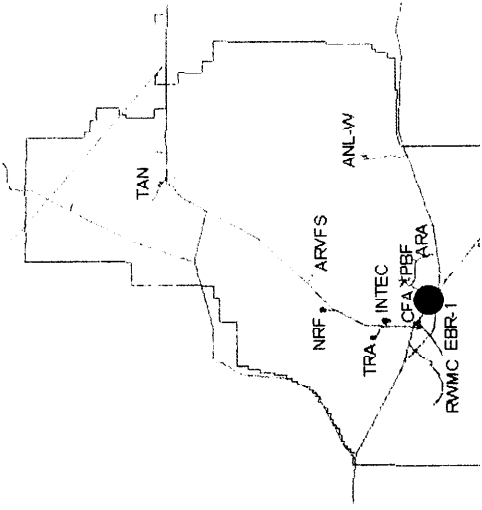


Security Training  
Facility (STF)-02  
Gun Range



**LEGEND**

-  Building
-  STF Area Map
-  Berm
-  Pond
-  Kickout Area





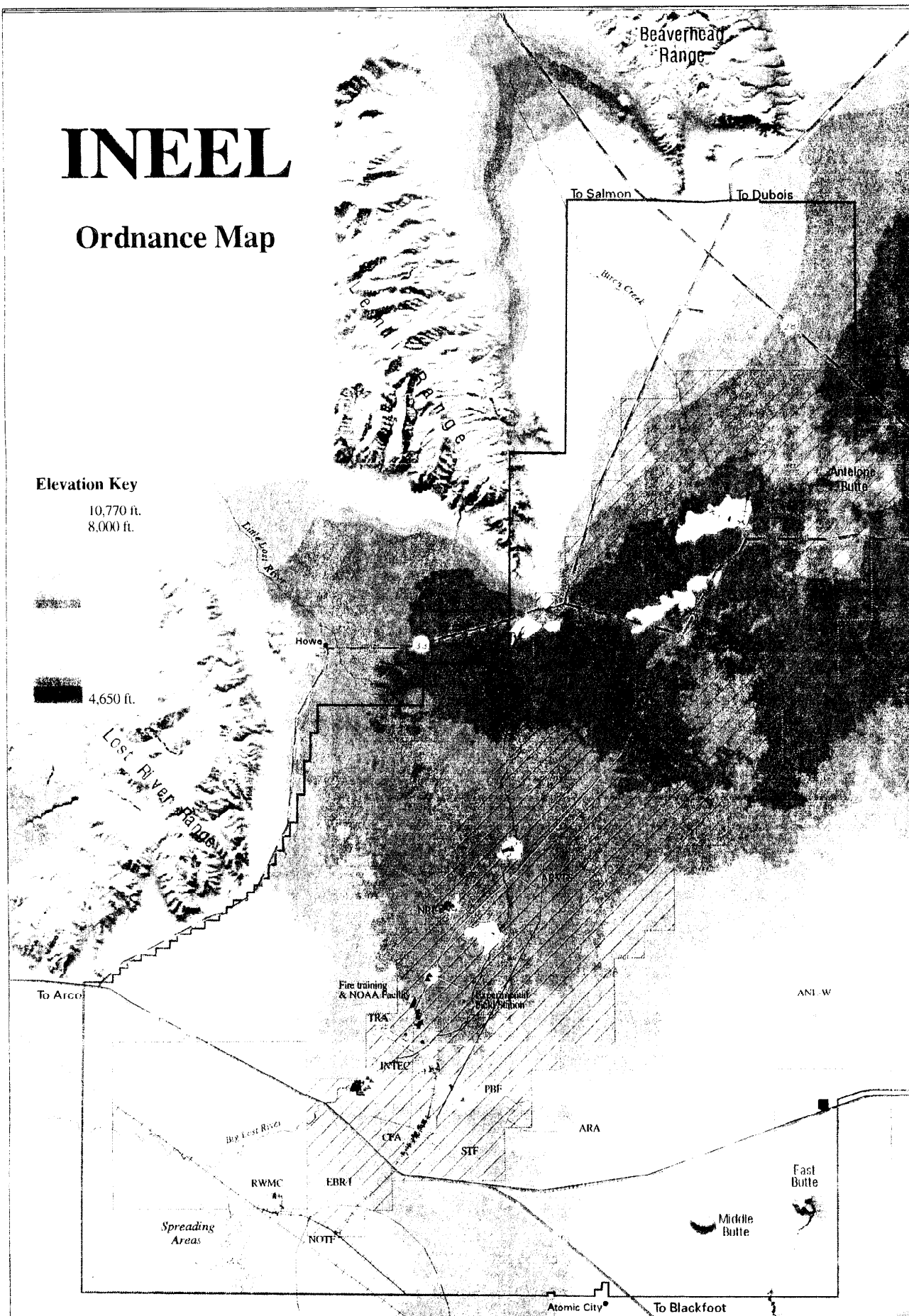
# INEEL

## Ordinance Map

### Elevation Key

10,770 ft.  
8,000 ft.

4,650 ft.



**Table 19-2.** Sites retained for the feasibility study based on potential ecological risks.

Site	Contaminant of Concern	Hazard Quotient
Fire Station II Zone and Range Fire Burn Area	2,4,6-Trinitrotoluene	$\leq 1$ to $\leq 40$
	RDX	$\leq 1$ to $\leq 40$
Experimental Field Station	1,3-Dinitrobenzene	$\leq 1$ to $\leq 80$
	2,4,6-Trinitrotoluene	$\leq 1$ to $\leq 300$
Land Mine and Fuze Burn Area	2,4,6-Trinitrotoluene	$\leq 1$ to $\leq 10,000$
NOAA	1, 3-Dinitrobenzene	$\leq 1$ to $\leq 200$
	2,4,6-Trinitrotoluene	$\leq 1$ to $\leq 500$
	RDX	$\leq 1$ to $\leq 20$
NODA	RDX	$\leq 1$ to $\leq 4,000$
STF	Lead	$\leq 1$ to $\leq 2,000$

**Table 19-3.** Summary of sites addressed in the feasibility study.

Contaminated Soils	Human Health Site	Ecological Site
Firestation	X	X
Fieldstation	X	X
Mine/Fuze	X	X
NOAA	X	X
NODA Area 2	X	X
STF-02 Gun Range	X	X
UXO Areas		
Down Range Area	X	
Bombing Ranges	X	

## 19.2 Assumptions

These are the principal assumptions that were incorporated into the development and preparation of the WAG 10 comprehensive FS:

1. Ecological risks will be reduced to acceptable levels by remedial actions implemented to reduce human health risks for those sites presenting both types of risks, with the exception of institutional controls.
2. A soil repository called the INEEL CERCLA Disposal Facility (ICDF) will be constructed south of the INTEC and will be operational by 2004. This facility will be permitted to receive CERCLA waste generated on the INEEL that meets the Agency-approved waste acceptance criteria, which will be developed during remedial design (DOE 1999).
3. All soils in WAG 10 except at STF-02 are not RCRA hazardous waste or Toxic Substances Control Act (TSCA)-regulated waste (15 USC § 53).
4. DOE policy will allow recycle of the metal debris from STF-02 Gun Range.
5. The soils and creosote-treated railroad ties at STF-02 are only RCRA-regulated for lead: no other contaminants exist that would be RCRA regulated.
6. The INEEL-wide monitoring programs for air will be adequate for all alternatives leaving contamination in place because the Baseline Risk Assessment (BRA) (see Sections 5 to 18 and Appendix E) did not identify risks from air pathways in excess of 1E-04 at WAG 10.
7. In the absence of specific tribal recommendations, existing remedial approaches and monitoring efforts can be used in conjunction with consultation under cultural resource and other environmental applicable or relevant and appropriate requirements (ARARs) to demonstrate a good faith effort to address qualitative Native American concerns.

## 19.3 Remedial Action Objectives

Remedial Action Objectives for WAG 10 were developed in accordance with the *National Oil and Hazardous Substances Contingency Plan* (NCP) (40 CFR 300) and EPA guidance (EPA 1988) and through the consensus of DOE-ID, EPA, and IDEQ participants. The RAOs are based on the results of both the human health risk assessments (HHRAs) and ecological risk assessments (ERAs) and are specific to the COCs and exposure pathways developed for WAG 10.

The conclusions from the Remedial Investigation (RI)/BRA that were used to develop RAOs are summarized below:

- Ingestion of homegrown produce, dermal adsorption of soil, ingestion of soil, and ingestion of groundwater are the only human health exposure routes with unacceptable estimated risks for the TNT/RDX soil sites.
- Exposure to lead contamination in soil above 400 mg/kg poses an unacceptable risk. This is based on the revised interim soil lead guidance for CERCLA sites and RCRA Corrective Action Facilities (EPA 1994) and precedence for cleanup at the INEEL.

- From the simulated infiltration of lead from STF-02, groundwater concentrations of lead will exceed the MCL.
- Risks associated with the air pathway are well below 1E-04. Therefore, RAOs for the air pathway are not required. (Note: Appropriate safety measures, as determined by air emissions calculations, will be implemented during remedial actions to ensure that dust emissions do not exceed the limits specified by ARARs.)
- The unexploded ordnance (UXO) sites were excluded from quantitative analysis in the BRA. However, the potential UXO at these areas presents an unacceptable risk of acute physical injury from fire or explosion resulting from accidental or unintentional detonation. Therefore, an RAO for UXO was developed.

The RAOs specified for protecting human health are expressed both in terms of risk and exposure pathways, because protection can be achieved through reducing contaminant levels as well as through restricting or eliminating exposure pathways. The overall intent of the human health RAOs is to limit the cumulative carcinogenic human health risk to less than or equal to 1E-04, and noncarcinogenic exposure to less than or equal to an HQ of 1. The RAOs specified for protecting ecological receptors inhibit adverse effects from contaminated soil and tank contents on resident populations of flora and fauna.

The RAOs developed for WAG 10 to protect human health and ecological receptors are as follows:

- Inhibit dermal exposure to and ingestion of contaminated soils and food crops with a total excess cancer risk level of greater than 1E-04 and noncarcinogenic COCs with HQs greater than 1 for current and future workers and future residents.
- Inhibit exposure to soils contaminated with lead at concentrations greater than 400 mg/kg.
- Inhibit ingestion of groundwater with contaminant concentrations exceeding MCLs or risk-based concentrations.
- Inhibit any inadvertent contact with potential UXO by onsite workers and members of the public.
- Inhibit ecological receptor exposures to soil contaminated with COCs, primarily concentrations in soils that result in an HQ greater than or equal to 10.0. The RAO excludes naturally occurring elements and compounds that are not attributable to historic releases.

### **19.3.1 Contaminants and Sites of Concern**

The contaminants that contribute to human health risks, listed in Table 19-1, were evaluated in the FS. Of all the potential contaminants that were analyzed, only two were determined in the HHRA to have excess cancer risks greater than 1E-04: TNT at the Firestation, Fieldstation, Mine/Fuze, and NOAA soil sites, and RDX at the NODA Area 2 soil site. Lead present in STF-02 soils at concentrations greater than 400 mg/kg is also defined as a COC. Because UXO presents an immediate risk of acute physical injury from accidental or unintentional detonation, potential UXO within the UXO areas is identified as a COC. The COCs for WAG 10 sites retained based on ecological risks are shown in Table 19-2. Six sites were found to have HQs greater than 10 following the ERA: Fire Station for RDX and TNT; NOAA for RDX, TNT, and 1,3 dinitrobenzene; NODA Area 2 for RDX; the Experimental Field Station for TNT and 1,3 dinitrobenzene; Mine/Fuze for TNT, 1,3 dinitrobenzene, and 2,4 dinitrotoluene; and the STF-02 Gun Range for lead.

Media of concern for WAG 10 sites consist of contaminated soils and UXO. In addition, minor amounts of debris are associated with the STF-02 Gun Range. The debris includes 70 railroad ties, the wooden building, and the asphalt pads. The railroad ties and other debris do not pose a risk as there is no pathway for exposure; they are being addressed because it will be necessary to remove them in order to remediate the soil.

The soils at the TNT/RDX sites are contaminated with low to moderate levels of TNT and RDX. At the STF-02 Gun Range there are approximately 61 tons of lead and 3.4 tons of copper debris in the soil berms and kickout area. This debris is in the form of metal fragments and unfired artillery rounds. After removal of the metal fragments, analysis indicates the amount of lead adsorbed on the soil is low to moderate. The 70 railroad ties used for supporting targets are impregnated with lead bullets. The wooden building and asphalt pads are not contaminated with lead. Based on available data, which include total analysis for organics and heavy metals and TCLP test results, none of the soils, except in STF-02, are identified as RCRA-hazardous waste. The soils at STF-02 may be RCRA-toxic for lead. However, available analysis is inconclusive as to the extent of soils that exceed the RCRA TCLP for lead. A summary of the maximum dimensions of the contaminated soil sites and the waste volumes contained in the TNT/RDX soil sites and the STF-02 Gun Range is provided in Table 19-4.

### **19.3.2 Exposure Scenarios and Pathways of Concern**

Exposure scenarios and pathways of concern for human health are identified in Table 19-1. As shown in the table, excess cancer risk exceed  $1E-04$  for four pathways: soil ingestion, ingestion of homegrown produce and groundwater, and dermal absorption. The soil ingestion risk exceeds  $1E-04$  for TNT at Mine/Fuze and NOAA soil sites. The ingestion of homegrown produce exceeds  $1E-04$  for TNT at Firestation, Fieldstation, Mine/Fuze and NOAA sites; and for RDX at NODA Area 2. The groundwater risk exceeds  $1E-04$  for TNT at NOAA.

Lead concentrations in the soil at the STF-02 Gun Range exceed the 400 mg/kg EPA screening level and, if allowed to migrate, could result in groundwater contamination exceeding the MCL for lead.

Inadvertent contact with potential UXO in the UXO areas pose an immediate threat to onsite workers and members of the public.

The exposure pathways of concern for the ecological receptors are ingestion of contaminated vegetation and prey and incidental ingestion of soil.

### **19.3.3 Preliminary Remediation Goals**

Preliminary remediation goals (PRGs) are quantitative cleanup levels used to plan remedial actions and assess the effectiveness of remedial alternatives. Final remediation goals are based on the results of the BRA, ARARs, and the evaluation of expected exposures and risks for alternatives. The effects of multiple contaminants also are taken into consideration. Final remediation goals will be presented in the WAG 10 Record of Decision (ROD).

Typically, PRGs to address human health are based on media-specific COC concentrations associated with an excess cancer risk of  $1E-04$  or a HI of 1.0, whichever is more restrictive. For WAG 10, the PRGs for individual COCs were defined by calculating contaminant concentrations in soil that would result in an excess cumulative cancer risk of  $1E-04$  to hypothetical residents at the end of the 100-year institutional control period. A given COC may have different PRG values at different sites because some sites have multiple COCs affecting the same exposure pathway. For example, if a given site only has one contaminant requiring remediation, the PRG for the contaminant would equal the

contaminant concentration equivalent to a risk of 1E-04. If, however, the site has two contaminants requiring remediation, the PRG for each contaminant would equal one-half of the concentration associated with an excess risk of 1E-04 (i.e., risk of 5E-05) for each contaminant, so that the total risk for the site would be limited to 1E-04.

The PRGs to address ecological risks are based on soil concentrations associated with either an HQ equal to 10 or as determined as discussed in Appendix E. Table 19-5 provides the human health and ecological PRGs for WAG 10.

## 19.4 General Response Actions

General response actions (GRAs), which are broad categories of remedial actions to satisfy RAOs, were identified for the environmental media associated with WAG 10 sites. To protect human health and the environment, the intent of GRAs is to eliminate source-to-receptor pathways by preventing the exposure of a receptor to contaminants and reducing or eliminating contaminant migration to clean media.

**Table 19-4.** Areas and volumes of contaminated media for WAG 10 TNT/RDX soil sites and STF-02 Gun Range.

Site Name	Area of Site m <sup>2</sup> (yd <sup>2</sup> )	Contaminated Soil Volume m <sup>3</sup> (yd <sup>3</sup> )	Waste and Debris Volume m <sup>3</sup> (yd <sup>3</sup> )
<i>TNT/RDX soil sites</i>			
Experimental Field Station	20,300 (24,300)	76.5 (100)	NA
Fire Station	137,000 (164,000)	76.5 (100)	NA
NOAA	257,200 (307,600)	268 (350)	NA
Mine/Fuze	123,500 (147,700)	153 (200)	NA
NODA Area 2	6,900 (8,300)	38 (50)	NA
<i>STF-02 Gun Range</i>			
Gun Range soil site	9,570 (11,450)	14,900 (19,450)	NA
Leach Pond	1,300 (1,600)	405 (530)	NA
70 creosote-treated railroad ties (6 in. ×8 in. ×10 ft)	NA	NA	6.7 (8.7)
Asphalt pads	90 (107)	NA	2.1 (2.7)
STF-612 wooden building	NA	NA	3.8 (5)
Lead debris (fragments, unfired rounds)	NA	NA	4.8 (6.3)
Copper debris (fragments, unfired rounds)	NA	NA	0.2 (0.3)

**Table 19-5.** Preliminary remediation goals.

Site	Exposure Pathway	Human Health		Ecological		Range of Detected COC Concentrations at Site (mg/kg)	
		COC	PRGs (mg/kg)	COC	PRGs (mg/kg)	Minimum Conc	Maximum Conc
STF-02	Direct exposure and Groundwater	Lead	400	Lead	TBD <sup>a</sup>	3.05	24400
Fire Station	HGP & ERA	TNT	16	TNT	17	0.1	130
Field Station	HGP & ERA	TNT	16	TNT	17	0.14	1100
Mine/Fuze	GW & HGP & ERA	TNT	16	TNT	17	0.13	79000
NOAA	GW & HGP	TNT	16	—	—	0.1	17014
	ERA	—	—	RDX	0.7	0.11	53
NODA Area 2	HGP	RDX	4.4	—	—	0.115	328

a. Currently investigating a Monte Carlo approach to developing a more realistic preliminary remediation goal (PRG) for ecological receptors.

The GRAs, individually or in combination, can satisfy RAOs in one of two ways: (1) contaminants can be destroyed or reduced in concentration or (2) contaminants can be isolated from potential exposure and migration pathways. Contaminant destruction is the preferred method because it ensures that the RAOs have been satisfied. However, lead contamination at the STF-02 Gun Range cannot be destroyed and, therefore, must be isolated from potential exposure and migration pathways.

A range of GRAs and a combination of GRAs that could achieve varying degrees of protectiveness of human health and the environment and compliance with RAOs have been defined. Five GRAs and combinations of GRAs were identified for WAG 10:

- No action
- Institutional controls
- Removal, ex situ treatment, and disposal
- Removal and disposal
- UXO detection, removal, and disposal.

The TNT/RDX soil sites may contain UXO, therefore use of heavy equipment to construct a barrier over these areas is not feasible because of safety concerns. Containment was also not considered practical for the UXO areas due to the large land area (over 250,000 acres) as well as the safety concern associated with potential UXO. The STF-02 Gun Range is within an area intended for future industrial use (DOE-ID 1996). Containment would result in creation of a hazardous waste landfill due to the large amount of lead present. Since this is not consistent with future land use plans, containment was not considered an appropriate response action.

In situ treatment was not considered practical for the TNT/RDX soil sites because no in situ technology has been demonstrated to effectively treat the fragments of TNT and RDX. Also, the TNT/RDX contamination exists in small, discrete, and widely spaced areas. The contamination levels at these sites are greater than 1000 ppm, which is toxic to plants (Rieger and Knackmuss 1995; Silciliano and Greer 2000). The lack of vegetation at these sites is further evidence that contamination is too high to effectively implement any phytoremediation technology.

The majority of the lead contamination at the STF-02 Gun Range is in the berm. In situ soil treatment technologies are designed to treat soil belowgrade and rely on surrounding soils for confinement of the operation. Because it is impractical to implement in situ treatment for lead in the soil berm, in situ treatment was not considered as a response action for the STF-02 soils.

A description of each GRA identified for the WAG 10 sites is presented below.

#### **19.4.1 No Action**

A “no action” GRA does not involve active remedial actions with the exception of environmental monitoring. Monitoring is included to enable identification of potential contaminant migration or other changes in site conditions that may warrant future remedial actions. Types of environmental monitoring considered for use at WAG 10 sites are defined in the description of alternatives presented in Section 20. Though the no action GRA may not achieve RAOs established for WAG 10, it is retained to serve as a baseline for evaluating remedial action measures.

#### **19.4.2 Institutional Controls**

Institutional controls are limited actions taken by responsible authorities to minimize potential danger to human health and the environment. Institutional controls are ongoing actions that can be maintained only as long as the responsible authority is in control of the site. Based on previous feasibility analysis for INEEL sites, active institutional control is required for a minimum of 100 years following closure. To remain consistent with the BRA, the 100-year institutional control period is assumed to begin in 2000 and end in 2100.

The institutional control measures included in this GRA are the access restrictions and administrative controls discussed in Section 19.5.2. The institutional control measures would be established and maintained, as necessary, where contamination remains in place to provide early detection of potential contaminant migration and to control exposures to contaminants. The effectiveness of these institutional controls would be evaluated by DOE-ID, EPA, and IDEQ during subsequent five-year reviews.

#### **19.4.3 Removal**

Removal technologies include the conventional or remote excavation and handling of contaminated material or structures in preparation for subsequent treatment, storage, or disposal. Another removal technology, soil vacuuming, uses a high-volume, high-vacuum, truck-mounted system to remove surface contaminated soils.

#### **19.4.4 UXO Detection**

Technologies for detection of buried UXO include magnetometers, conductivity meters, and ground-penetrating radar. Visual search methods can be used for identification of surface ordnance.